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Demographic and Socioeconomic Patterns of HIV/AIDS Prevalence in Africa

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Abstract

Understanding the demographic and socioeconomic patterns of the prevalence and incidence of HIV/AIDS in Sub-Saharan Africa is crucial for developing programs and policies to combat HIV/AIDS. This paper looks critically at the methods and analytical challenges to study the links between socioeconomic and demographic status and HIV/AIDS. Some of the misconceptions about the HIV/AIDS epidemic are discussed and unusual empirical evidence from the existing body of work is presented. Several important messages emerge from the results. First, the study of the link between socioeconomic status and HIV faces a range of challenges related to definitions, samples, and empirical methods. Second, given the large gaps in evidence and the changing nature of the epidemic, there is a need to continue to improve the evidence base on the link between demographic and socioeconomic status and the prevalence and incidence of HIV/AIDS. Finally, it is difficult to generalize results across countries. As the results presented here and in other studies based on Demographic and Health Survey datasets show, few consistent and significant patterns of prevalence by socioeconomic and demographic status are evident.

This paper—a product of the Poverty and Inequality Team, and Human Development and Public Services Team, Development Research Group—is part of a larger effort in the group to understand the determinant of the HIV/AIDS epidemic. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The authors may be contacted at kbeegle@worldbank.org and ddewalque@worldbank.org.

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I. Introduction

The demographic and socioeconomic patterns of prevalence and incidence of HIV/AIDS in Sub-Saharan Africa should shape the programs and policies to combat the epidemic. A large body of literature examines the relation in Africa between demographic and socioeconomics variables on the one hand and HIV infection on the other (for reviews of this literature, see Wojcicki 2005, Glick 2007, and Hargreaves and Glynn 2002). Among the issues addressed are the associations between HIV status and variables including education status, income (wealth or poverty), residency, age, marriage, and empowerment. With new and expanded datasets, researchers are increasingly able both to measure HIV status and to collect detailed socioeconomic variables for the same individuals in population-based samples, thus enabling more-detailed analyses than were previously feasible.[1] Moreover, with these data sources, we can focus on underlying factors which are more distal to HIV status (e.g. education, marriage) in addition to proximate factors or behavioral risk (e.g. sexual behavior such as condom use).

This paper aims to look more closely at the methods and unusual evidence from the existing body of work on the link between demographic factors, socioeconomic status and HIV/AIDS. Our objective is not to conduct a review of the array of empirical work looking at the pattern of HIV for different socioeconomic and demographic groups. Rather, we discuss the methodological challenges for such analysis and focus on some of the more controversial evidence about these patterns. The first section discusses some of the methodological issues that confront empirical studies of the relation between socioeconomic status and HIV.[2] The second section discusses some of the misconceptions about HIV/AIDS in Sub-Saharan Africa that persist in the literature and popular media despite accumulating evidence to the contrary. The last section provides some concluding remarks.

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[1] This paper focuses more on the population-based household surveys which now provide both HIV status and SES indicators. We are not suggesting that demographic surveillance sites (DSS) are not still crucial for assessing HIV prevalence across demographic groups. They are, however, generally lacking detailed socioeconomic characteristics of the DSS population.

[2] In a similar approach, Beegle and De Weerdt (2008) examine the methodological issues involved in the study of the impact of HIV on socioeconomic outcomes.

II. Methodological Issues

Researchers face a number of challenges in studying the relation between demographic and socioeconomic status and the prevalence of HIV. This section examines issues related to the measurement of outcomes of interest, the construction of socioeconomic indicators, the design of appropriate samples, and the modeling of the correlates of HIV.

Measuring Outcomes

For empirical work, understanding the correlates of HIV—a medical condition that is not easily detected or self-diagnosed—requires collecting data in ways that differ from those traditionally used in surveys. Customary sources for information on socioeconomic status (household surveys) rarely include medical testing for any health condition or information on risky behaviors correlated with HIV. Sources of information of HIV prevalence and sexual behaviors (such as antenatal clinics and other sentinel surveillance sites) tend to collect minimal information on only the basic demographic status of individuals, such as age and gender. In the rare cases in which a dataset offers both detailed demographic and socioeconomic status variables and includes measures of HIV status, samples are small or specialized, making it difficult to generalize the findings to the overall population. Important exceptions are the Demographic and Health Surveys [DHS] datasets.

Lack of data on individuals' socioeconomic and HIV status may have resulted in continued speculation about the relation between the two. As a result of the advent of population-based surveys with both socioeconomic status (at least basic indicators of status) and HIV status, such as the DHS program, the past several years have seen a large increase in the number of empirical studies of this relation.[3]

[3] For a discussion of some of the concerns about national population-based household surveys that include HIV testing (which relate to nonresponse rates), see García-Calleja, Gouws, and Ghys (2006). While the HIV prevalence estimates from large nationally representative sero-surveys such as the DHS might suffer from non-response bias if the willingness to be tested for the survey varies by HIV status, recent studies reviewing the DHS suggest that such bias, when present, is minimal (Mishra, Vaessen, Ties Boerma et al. 2006 ; Marston, Harris and Slaymaker 2008). However, Reniers and Eaton (2009) find that prior

Collecting information on the HIV status of individuals in household surveys is difficult for a variety of reasons, including costs, logistics (especially before the development of rapid tests methods, including dried blood spot rather than venous blood samples), and human subjects considerations. As a result researchers often substitute measures of the proximate determinants of HIV for actual HIV status. These measures include behaviors that are biologically associated with risk of HIV, including risky behaviors (not using condoms, having multiple partners) and circumcision status. Mishra et al. (2007) and Boerma and Weir (2005) discuss the application of the proximate determinants approach, which has been adapted from the study of fertility by demographers to the study of HIV.[4]

Identifying the socioeconomic status–HIV link using risk behaviors rather than actual HIV status is potentially problematic in ways that differ from those faced by demographers studying fertility. This is because observational data on behaviors and the prevalence of HIV are not always consistent with what is known about how HIV is contracted.

For example, clinical trials on the efficacy of circumcision in preventing HIV reveal that circumcised men are less likely to contract HIV (Auvert et al. 2005; Williams et al. 2006). But in some countries the opposite relation is observed: in Malawi the incidence of HIV in 2004 is estimated at 13.2 percent among circumcised males and 9.5 percent among uncircumcised males (NSO and ORC Macro 2005; Poulin and Muula 2007 present similar findings based on other data from Malawi). In Cameroon the incidence of HIV in 2003 is estimated at 4.1 percent among circumcised and 1.1 percent among uncircumcised males (INS and ORC Macro 2004). In Ethiopia the difference in HIV status between circumcised and uncircumcised males is negligible (0.9 percent among circumcised and 1.1 percent among uncircumcised males) (CSA and ORC Macro 2006).

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knowledge of HIV status informs decisions to participate in sero-prevalence surveys and therefore could produce bias in estimates of HIV prevalence.

[4] This approach is drawn from the seminal work of Bongaarts (1978) on the proximate determinants of fertility to understand fertility patterns. These determinants include the exposure risk of conceiving, usually measured by cohabitation; use of contraceptives; rates of abortion; pathological sterility; and postpartum infecundability.

As HIV in Africa is spread primarily through heterosexual contact, lack of condom use and multiple partners should, all else equal, be associated with higher prevalence. Yet in Kenya HIV prevalence is higher among men who used a condom the last time they had paid sex (8.0 percent) than among men who did not (6.4 percent) (CBS, MOH, and ORC Macro 2004); it is much higher among men who had two partners in the past 12 months (9.7 percent) than among men who had three or more partners (3.3 percent). Among women in Cameroon who used a condom during their last sexual encounter in the past 12 months, HIV prevalence is slightly higher (7.5 percent) than among women who did not (7.0 percent) (INS and ORC Macro 2004).

These seemingly anomalous results, which are inconsistent with biological truths that condoms used throughout sexual history will lower prevalence, reflect the fact that risky behaviors are not undertaken in isolation.[5] Risky behaviors can reflect a person's perception of risk; whether a man uses a condom when paying for sex may depend on his assessment of his partner's risk of being infected with HIV. These apparent paradoxes may also reflect the difficulty of collecting accurate self-reported information on risky behaviors (Adams, Trinitapoli, and Poulin 2007; Gersovitz 2005) and measuring trends in these behaviors, especially when concepts, perceptions, and attitudes as well as the wording of survey questions change (Glick 2007).

The relation between socioeconomic status and risky behaviors does not necessarily shed light on the relation between socioeconomic status and HIV status. Sexual behaviors, at least in isolation, are not necessarily substitutes for measuring HIV status. Thus, finding a correlation between a socioeconomic status (SES) indicator and a risky sexual behavior (e.g. lack of condom use at last sex) does not imply the same correlation between that SES indicator and HIV status. This also extends to knowledge. Knowledge about HIV does not necessarily translate into behaviors associated with prevention (see, for example, Booysen and Summerton 2002); knowledge about one's own status may not affect the propensity to buy condoms (Thornton 2005).

[5] They may also reflect the fact that lower condom use at last sex may say little about condom use throughout sexual history.

Defining Socioeconomic Status

Socioeconomic status (SES) is a multidimensional, context-specific concept that is not measured consistently across household surveys (Bollen, Glanville, and Stecklov 2001). The same problem may affect studies of the link between SES and HIV. Although, since most of these studies focus on the DHS datasets, the lack of consistency with which different studies define SES is not necessarily the issue. The focus here is rather on three potential problems of interpretation related to: measurement of SES and underlying causes, proxy measures of income in lieu of explicit income data, and, current income position versus accrued wealth.

First, measuring differences in the SES gradient with respect to HIV does not explain underlying causes of the gradient. Education as an SES measure, for example, encompasses many underlying factors that influence its relation with HIV status. The link between education and HIV may reflect the fact that, on average, people with less education have less disposable income, have less access to information about safer sex, live in more remote areas, and are less physically mobile than people with more education.[6] All of these factors can affect likelihood of HIV infection. Even if some of these relationships can be decomposed by added additional variables to an analysis (see Wagstaff et al 2003), one is likely still left with multiple story lines on the pathway through which a singular SES measure results in differential HIV outcomes.

Second, the asset index approach (developed by Filmer and Pritchett 1999), which is often applied to DHS data in lieu of detailed income or consumption measures, closely approximates the ranking of households based on consumption (which underlies the poverty definition in the first MDG) in specific settings but not necessarily everywhere (Filmer and Scott 2008). The extent to which there is a congruence of rankings of households between the asset index and consumption affects how one interprets the asset index (as a good or weak proxy for poverty, for example).

Third, terms such as *wealth, poverty,* and *income* are often used interchangeably to describe the asset index (see, for example, Mishra et al. 2007), which may not reflect current income or even current poverty status (Filmer and Scott 2008).

[6] Jukes et al (2008) develop and discuss a theoretical framework for the link between education and HIV.

Sample Design

The wide variation in HIV prevalence both across and within African countries, especially the low prevalence in some countries, requires alternatives to random sample designs (or the traditional two-stage random designs used by most household surveys, including the DHS). About two-thirds of the population in Sub-Saharan Africa resides in countries with prevalence of less than 5 percent (see appendix Table 1). Among the 18 poorest countries in Sub-Saharan Africa (countries with GNI per capita of $350 or less), the prevalence of HIV in 11 of them (comprising more than 70 percent of this population of 324 million) is less than 5 percent. Even in high-prevalence countries, substantial regional variation exists. In the North Eastern province of Kenya, for example, none of the DHS sample of men (N = 48) or women (N = 60) tested positive for HIV (CBS, MOH, and ORC Macro 2004). To ensure sufficient sample sizes, researchers often use purposive sample designs (albeit maybe still random). Such designs may make it difficult to generalize results, raising the question of external validity. Clark's (2004) careful study on early marriage, discussed later in this paper, draws on an urban sample of young women in Kenya and Zambia of 167 and 135 respondents, respectively. This reflects the challenge of conducting detailed analysis with integrated socioeconomic and HIV-status data, but having samples sufficient to describe national situations.

Understanding the Correlates of HIV

Quantitative studies of socioeconomic status and HIV entail analysis of survey data to produce correlations or, depending on the data and techniques, identify causal relations. The relationship identified between indicators of socioeconomic status and HIV status (or proximate measures) depends on the models used. The least complex approach is to examine bivariate relations, but bivariate correlations between a single indicator of socioeconomic status and HIV can produce misleading results, in part because of the multiple underlying factors that any one socioeconomic status measure captures.

Consider simple examples from Ethiopia and Kenya (Table 1). Among national samples of women in Ethiopia and men in Kenya, there appears to be a positive relation between education and HIV infection. However, by simply dividing the sample into rural and urban areas, this relation disappears. The change reflects the fact that HIV infection in Africa is higher in urban areas, where education levels of adults are also higher. Thus the positive correlation between education and HIV status suggested by the first rows for both countries in Table 1 is driven entirely by the fact that people in urban areas are both more likely to be HIV–positive and more educated; education may not be causally related to higher HIV infection probabilities. Consequently, how one interprets the link between education and HIV depends critically on how the correlation is modeled. As Hargreaves and Glynn (2002, p. 496) note, "Crude, unadjusted analyses can give misleading results."

A second example of the difficulty in studying the education–HIV prevalence gradient is drawn from early in the epidemic in Uganda. Data from Round 1 (1989/1990) of the General Population Cohort of the Medical Research Council in rural Uganda reveal how the education–HIV gradient depends on how other covariates are factored into the analysis. The mean of the marginal effects indicates that more-educated adults appear to be more likely to be HIV–positive than less-educated adults (column 1 of Table 2). The point estimate of the marginal effects suggests that, compared with the baseline of no education, having some primary education increases the probability of being infected by 2.9 percentage points and having some secondary education increases the risk by 5.5 percentage points. The second column of Table 2 introduces age dummies in the regression. Controlling for age, the positive relation between education and HIV infection actually disappears: the coefficients on the education category dummies lose their significance. This result reflects the fact that HIV prevalence is concentrated in age groups (20- to 40-year-olds) in which the proportion of better-educated adults is relatively high.[7] The correlation between HIV prevalence and the fraction of individuals with secondary education is very strong across age groups, confirming this interpretation (Figure 1).

This discussion emphasizes the importance of moving beyond bivariate and simple multivariate analyses to examine how demographic and socioeconomic status indicators relate to HIV prevalence. Of course, one needs to be cautious about over-controlling for other factors: as de Walque (2009) and Hargreaves and Glynn (2002) note, "over-adjusted" analyses may mask some true associations. In their review of studies on the

[7] In an earlier study of risk factors for HIV, Nunn and others (1997) found a positive association between education and HIV seropositivity, but the result was not robust when corrected for age.

link between education and HIV status, Hargreaves and Glynn (2002) exclude studies they define as over-adjusted (although they are not entirely clear on what this constitutes); they include studies with behavioral factors (such as multiple partners, condom used, and other proximate determinants of HIV) as covariates. Wojcicki (2005) advises against including behavioral (or choice) variables related to sexual behaviors as right-hand-side variables, because they are a function of the socioeconomic status and demographic variables of interest. Over-adjustment can also pertain to other covariates which are also distal/underlying determinants but which may mediate the "true" effects of covariates of interest (Hargreaves and Glynn 2002).[8] To capture the "true" effect of education on HIV status, for example, one might consider excluding occupation variables among the covariates, as occupations are determined by education.

III. (Un)Established Links between Socioeconomic Status and HIV

Misconceptions about the HIV epidemic have the potential to stall or impede efforts to prevent and treat the disease, as Shelton (2007) notes. Despite the accumulation of evidence, many misconceptions persist.

Poverty

To what extent is poverty to blame for the AIDS epidemic? Globally, the countries hardest hit by the AIDS epidemic are poor; within Sub-Saharan Africa the relationship between HIV prevalence and income (poverty) is not clear at the country level (Figure 2). And, in fact, some of the hardest hit countries are relatively richer. Within countries, deteriorating economic conditions might even slow the spread; in Zimbabwe the decline in HIV prevalence has been attributed to the large decline in economic growth (Timberg 2007) (although this relation has not been established empirically).

Despite the lack of evidence (as noted by Gillespie, Kadiyala, and Greener 2007; Wojcicki 2005; Shelton, Cassell, and Adetunji 2005; and Glick 2007), poverty continues to be associated with the epidemic (see, for example, Fenton 2004). This body of work

[8] Note that we draw a distinction between proximate determinants, such as sexual behaviors that quite directly expose one to HIV infection, and distal (underlying) determinants that drive these behaviors and, ultimately, HIV status.

considers both the "downstream" impact of AIDS on poverty and inequality, as well as the "upstream" impact of the poverty and inequality on the epidemic itself (Piot, Greener, and Russell 2007). Often, these analyses rely on cross-country data, which suffer from the problems seen in bivariate correlations. Moreover, analysis of economic growth and HIV/AIDS tends to examine the impact of HIV/AIDS *on* economic growth (growth in GDP per capita), using cross-country regressions, neoclassical growth models, or computable general equilibrium models, rather than the impact of poverty or economic status on national estimates of the prevalence of HIV/AIDS (Haacker 2004).

A number of compelling arguments have been made that would support the notion that poverty causes AIDS. A simplistic reason underpinning this view is that health and disease exposure are usually positively correlated with poverty: richer people live longer, are in better health, and are less exposed to the deadliest diseases in low-income countries (diarrheal diseases, malaria, and so forth). This argument, however, is flawed because HIV/AIDS is contracted very differently from other contagious diseases. In fact, it is associated with behaviors and characteristics that are often associated with higher income (lower poverty), such as more concurrent partners, geographic mobility, and urbanization. Glick (2007) characterizes these traits as those that are a direct function of wealth (for example, increased demand for partners) and those that are correlated with wealth (such as residence and population density). Even if there were evidence that the effect of wealth on HIV is not direct but indirect, increases in wealth or income that can be affected by policies cannot easily be disassociated from the "correlation" effect. Greater opportunities for income earning may result in more mobility and urbanization, both of which are associated with HIV.

From a policy perspective, then, the weakly positive SES-HIV/AIDS link seems at odds with "pro-poor" efforts with respect to health policy – that is, targeting diseases and morbidities that afflict the poor. Efforts to direct health spending to ARV treatment can shift the benefit incidence of health spending *away* from the poor and to the rich. One may speculate that continued perception that HIV/AIDS is a disease of the poor makes HIV/AIDS spending more politically feasible. A more complicated argument would be that even if HIV/AIDS spending is targeting more wealthy populations (or not otherwise pro-poor), prospects for economic growth and poverty reduction in the overall economy are compromised by the epidemic. This is the premise underlying the down-stream arguments that HIV/AIDS causes poverty, even though there is (also) weak evidence of this.

Early Marriage

An alarming demographic trend in developing countries has been the steadily increasing percentages of adolescents and women who are HIV–positive. These patterns have been identified as reflecting marriage patterns and risk. Clark, Bruce, and Dude (2006) argue that early marriage by females presents an important risk factor for HIV infection that is generally not being addressed and that could be contributing to the increase in HIV among this relatively large segment of the population (almost a third of girls 10–19 in developing countries marry before their 18th birthday).

Using data from 22 DHS conducted in Africa and Latin America and the Caribbean, Clark, Bruce, and Dude (2006) conclude that four factors increase the vulnerability of young brides to HIV infection. First, marriage dramatically increases the frequency of unprotected sex for most young brides. In almost all of the countries studied, the proportion of females 10–19 reporting having had unprotected sex in the past week was higher among those who were married than those who were not. Second, many young brides marry older men, who are more likely to be HIV–positive because of their increased window of sexual activity. Young brides are also more likely to be second or third wives in polygamous marriages. They have little power to ensure their husbands have only one partner, inside or outside marriage. Third, young brides often have less education than older brides, as well as less exposure to media, both important sources of information about HIV. Fourth, because of the age and education gaps between young brides and their husbands, young married girls and women have little possibility of using the most commonly promoted HIV prevention techniques of abstaining from sex or using condoms.

Based on these hypothesized pathways, the authors conclude that young married females are at significant risk for HIV infection. Few prevention efforts are targeted at these girls and women. Though the context for each country demands tailored policy approaches, Clark, Bruce, and Dude (2006) suggest that efforts to delay early marriage and to make sex within marriage safer by increasing HIV testing, promoting condom use, and reducing spousal age differences may help address the problem of HIV infection among this group of young women.

Although it seems reasonable to posit that females who marry young are at relatively high risk of contracting HIV, the actual prevalence of HIV among young wives remains unknown. In determining policy approaches and prevention efforts, it is important to determine whether the rate of HIV infection among young married adolescents is indeed as high as or higher than that of other women their age who are sexually active but unmarried.

Clark (2004) documents the increased risk of HIV infection for young married females by comparing prevalence data among the partners of young married females and the boyfriends of unmarried females the same age. She reports that in Kenya 30.0 percent of male partners of young wives are HIV–positive, while only 11.5 percent of partners of unmarried females the same age are seropositive. In Zambia 31.6 percent of partners of young wives and 16.8 of partners of unmarried females the same age are HIV–positive (Bruce and Clark 2004).

Clark (2004) shows that HIV infection rates peak among married women 15–24 before gradually declining. In contrast, the HIV infection rates for married men peak at 30–34. These are generally the ages when women and men marry. She also shows that the HIV prevalence rate is significantly higher among married women and men than among unmarried, sexually active women and men the same age. She finds that being married raises the risk of being HIV–positive by 75 percent among sexually active women 15–19. These findings suggest that early marriage is a risk for contracting HIV, although, as noted earlier, the study relies on a small sample from two urban areas of Kenya and Zambia.

Bongaarts (2007) draws the opposite conclusion. His analysis, based on DHS in Ghana and Kenya and on cross-country comparisons, suggests that late marriage and a long interval between first sex and first marriage are risk factors for HIV infection.

Data from the first five DHS that include HIV testing for a nationally representative sample of the adult population and much larger sample sizes allow the risks early marriage poses for HIV infection to be assessed (Table 3). The datasets are from Burkina Faso (2003), Cameroon (2004), Ghana (2003), Kenya (2003), and Tanzania (2003–04), five countries with different HIV/AIDS epidemics (See GSS, NMIMR, and ORC Macro 2005; INS and ORC Macro 2004; INSD and ORC Macro 2004; NBS and ORC Macro 2005; CBS, MOH, and ORC Macro 2004). The five datasets include very similar variables, allowing easy comparisons across countries. The questionnaire content of the DHS is similar to that used by Clark, Bruce, and Dude (2006).

The relation between the HIV infection rate, the dependent variable, and the marital status of women under the age of 24 is examined by dividing the data into three groups of women, those are 15–19, 20–24, and 15–24. The women are further divided into two groups: one that includes all women in an age range, the other that includes only women who self-report being sexually active. Restricting the analysis to sexually active women allows a more natural comparison of the riskiness of sexual activity inside and outside marriage. Looking at all women allows the sexual debut dimension to be integrated. In addition to marital status (ever married versus never married), the control variables included in the regressions are: years of education; dummies for age, urban location, ethnicity (not available in Tanzania), religion, region, and wealth index; and one interaction between ever married and being in a polygamous union.

For 15- to 19-year olds, early marriage seems to be protective of HIV infection in Burkina Faso, among both all women and self-reported sexually active women; ever having been married carries a statistically significant negative coefficient. In the other four countries, the coefficients on ever being married are not statistically significant. For women 20–24, early marriage seems to be protective for women in Burkina Faso and Ghana.

Marriage seems to be associated with a greater risk for HIV infection in women 15–19 in Cameroon, in women 20–24 in Tanzania, and in the pooled group of women 15–24 in both countries. The coefficient on marriage is not significant when the sample is limited to women who self-report as being sexually active.

Overall, except in Cameroon, these results do not support the hypothesis, advanced by Clark (2004), that early marriage increases the HIV risk for women. Getting married at an early age does not seem to put young married women at any greater risk of contracting HIV than women their age who do not get married.

Except in Burkina Faso, marriage does not seem to protect women against HIV either. Those women who get married younger face the same (high) risk of contracting HIV as women who get married later. It is therefore important that this group of women not be ignored in prevention efforts and policies.

The diverging results across the five countries may reflect cultural differences or different levels of the epidemic in each country. HIV prevalence is higher in Cameroon and Tanzania, the only two countries in which in marriage appears to be a risk factor for some groups of women, than in Burkina Faso, the only country in which marriage appears to be protective.

Discordant Couples

Recent research on discordant couples (couples in which only one partner is HIV–positive) in five countries—Burkina Faso, Cameroon, Ghana, Kenya, and Tanzania—yields two findings that challenge conventional notions about HIV transmission (de Walque 2007). First, in at least two-thirds of HIV–positive couples (couples with at least one HIV positive partner), only one partner is HIV–positive. Second, in many such couples only the woman is positive. These findings have very important implications for HIV prevention policies. This section extends the work of de Walque to include several new DHS surveys that included HIV testing (Côte d'Ivoire, Ethiopia, Guinea, Lesotho, Malawi, Niger, Rwanda, Senegal, and Zimbabwe).

A pervasive, if unstated, belief is that males are by and large responsible for spreading the infection among married and cohabiting couples (see UNAIDS, UNFPA, and UNIFEM 2004). HIV prevention policies should take into account the fact that partners who are not yet HIV–positive are an important target group and that women are almost as likely to transmit the infection to their uninfected partners as men are.

In nine out of 13 countries studied, less than one-third of couples directly affected by HIV are concordant positive (both partners are HIV–positive) (Table 4).[9] The figure is 42 percent in Malawi, 44 percent in Rwanda, 53 percent in Zimbabwe, and 59 percent in

[9] In Senegal the number of infected couples is too low to perform a meaningful statistical analysis.

Lesotho.[10] This finding suggests that expanding prevention efforts to include partners of HIV–positive individuals—by promoting joint voluntary counseling and testing among couples, for example—may help prevent further transmission (Allen et al. 2003).

In 9 of the 13 countries studied, the fraction of HIV–affected couples in which only the females are positive exceeds 30 percent. The figure is 48.2 percent in Ethiopia and 51.0 percent in Côte d'Ivoire. This figure is lower, but still sizable, in Malawi (24 percent), Rwanda (21 percent), Zimbabwe (19 percent), and Lesotho (14 percent), the same countries in which the proportion of concordant positive couples is higher. These findings challenge the notion that males are the primary channel for HIV transmission from high-risk groups to the general population; they may also contradict self-reports of sexual behavior by females.

Within cohabiting couples, self-reported sexual intercourse outside the union during the previous 12 months is generally much lower among women than men. In Burkina Faso, for example, it is 0.7 percent for women and 8.7 percent for men. In Tanzania it is 4.1 percent for women and 22.0 percent among men. These figures should be viewed with some caution, however, as substantial reporting biases in self-reported sexual behavior among both men and women have been reported (Gersovitz 2005; Gersovitz et al. 1998).

De Walque (2007) explores alternative explanations for the sizable portion of discordant couples in which only the woman is HIV–positive. These include polygyny (marriage to several wives), bias in the coverage of HIV testing in the survey, and unions or infections before the current union. For the most part, these possibilities do not explain the data in Burkina Faso, Cameroon, Ghana, Kenya, or Tanzania.

To exclude most cases of infections before the current union, the sample is limited to couples in which the woman has been in only one union for 10 years or more (Table 5). In five countries the number of HIV–positive couples who had been in the same union for at least 10 years is too small for meaningful statistical analysis. In the other countries the proportion of discordant female couples decreases, but not very substantially. The proportion of discordant female couples in Côte d'Ivoire, Cameroon, and Kenya still

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[10] Three of these countries (Malawi, Zimbabwe, and Lesotho) have the highest overall HIV prevalence of the 13 countries studied, suggesting that the probability that both partners are infected rises as the epidemic is diffused widely in the population.

exceeds 30 percent of HIV-positive couples. It is 20–30 percent in Burkina Faso, Malawi, and Tanzania and 10–20 percent in Zimbabwe, Rwanda, and Lesotho.

Comparison between Tables 4 and 5 suggests that infection before marriage may explain some, but not all, of the cases of couples in which only the woman is HIV–positive. In many of the countries studied, HIV infection before the union does not explain the sizable proportion of discordant female couples. That proportion is difficult to explain unless women are also sexually active outside the union.

Sexual intercourse among women outside marriage (or the cohabiting union) may be more common than reported. Even if it is infrequent, women may be more vulnerable to infection during such encounters, if, for example, they are less likely to use condoms than unmarried women or married men. Sexual intercourse outside the union increases women's vulnerability to HIV. Designing prevention efforts for this population of women will not be easy, given the culture of silence around women's sexuality in many African countries and the stigma attached to people, particularly women, living with HIV/AIDS. Efforts nevertheless need to be made, as ignoring the role female sexual activity outside the union plays in the transmission of the epidemic would be a disservice to women and to men.

IV. Conclusion

Understanding the demographic and socioeconomic patterns of prevalence and incidence of HIV/AIDS in Sub-Saharan Africa is crucial for developing programs and policies to combat HIV/AIDS. Rather than review the large body of studies on this topic, the objective of this paper is to discuss the methodological challenges facing such work and highlight some of the more controversial evidence about these patterns.

Several important messages emerge from the results presented in this paper. First, it is important to bring a critical eye to empirical evidence on the link between SES and HIV carefully, especially as related to definitions, sample design, and empirical methods. Sexual behaviors which may be viewed as proximate determinants of HIV are not necessarily correlated with actual HIV status. For example, risky sexual behaviors with low-risk partners may not increase the likelihood of contracting HIV. Attention to the details of sample and methods matters in interpreting results. A positive education-HIV gradient may mask the urban-rural pattern of the disease, rather than an actual association between schooling and prevalence.

Second, gaps in knowledge exist and so there is a need to continue to improve the evidence base on the link between demographic and socioeconomic status and the prevalence and incidence of HIV/AIDS. The introduction and scaling up of antiretroviral therapy (ART) in most African countries profoundly affects the dynamics of the epidemic and has the potential to modify the links between demographic/socioeconomic variables and HIV. If ART is available for specific groups (such as wealthier or more urban populations), the prevalence of HIV will shift, controlling for changes in incidence. By reducing AIDS–related mortality, ART modifies the link between HIV prevalence and incidence, reinforcing the need for accurate measures of incidence (through, for example, panel or cohort studies including HIV tests), as a more appropriate indicator of the current state of the epidemic.

Finally, even with improved data sources, it will still to be difficult to generalize results across countries. Moreover, even within countries, patterns across regions (ethnic groups, urban/rural populations) can be starkly different. As shown in the studies cited and other results presented here, few consistent and significant patterns of prevalence by socioeconomic and demographic status are evident.

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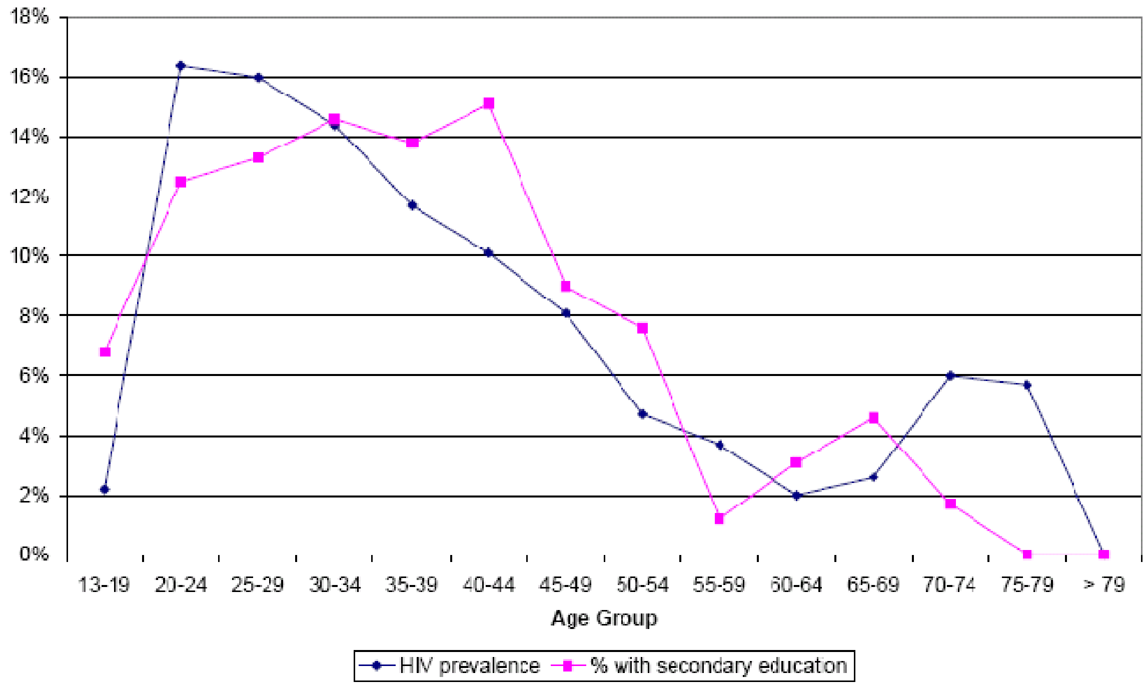
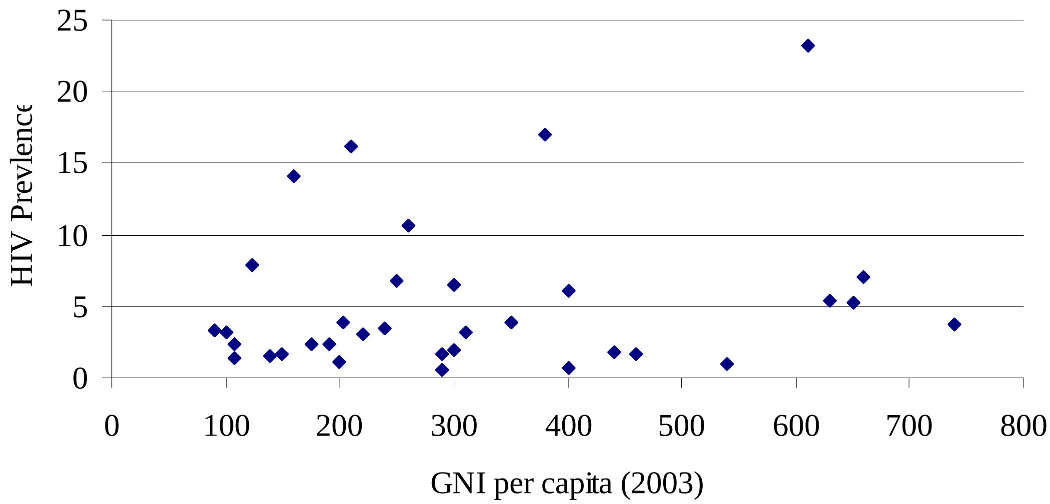
Figure 1: HIV prevalence and fraction with secondary education at each age group. MRC, General Population Cohort, Round 1 (1989/1990). (from de Walque, 2003)



Note: secondary is secondary education (grades 8 to 13) or above.

Figure 2: GNI per capita and HIV Prevalence Among 34 Sub-Saharan African Countries



Note: Excludes countries with GNI/capita above $1,000 (Swaziland, Naimibia, South Africa, Botswana, and Mauritius) and countries with missing HIV prevalence (Cape Verde, Sao Tome and Principe, Seychelles, and Liberia).

Table 1: HIV status by schooling and Residence

	No schooling	Some/completed primary	Post-primary
Kenya: Men 15-49			
All	2.5	4.7	5.0
Urban	10.0	10.6	5.5
Rural	1.1	3.6	4.8
Ethiopia: Women 15-49			
All	1.0	2.5	5.5
Urban	8.2	8.2	7.2
Rural	0.5	1.1	0.4

Source: Demographic and Health Surveys for Ethiopia 2005 (CSA and ORC Macro, 2006) and Kenya 2003 (CBS, MOH, and ORC Macro, 2004)

Table 2: HIV prevalence for adults 18+
MRC, General Population Cohort, Round 1 (1989/1990), Uganda.
(from de Walque, 2003)

Dependent variable: HIV positive	(1)	(2)
Primary (1-7 years)	0.029	-0.009
	(2.12)	(0.53)
Secondary (8+ years)	0.055	0.009
	(2.60)	(0.39)
Male	-0.009	0.015
	(0.82)	(1.02)
Married	-0.019	-0.003
	(1.40)	(0.16)
Previously married	-0.003	0.061
	(0.15)	(1.99)
Protestant	-0.003	0.001
	(0.17)	(0.06)
Muslim	-0.039	-0.062
	(2.68)	(2.65)
House mixed materials	-0.045	-0.024
	(3.59)	(1.44)
House hard materials	-0.023	-0.007
	(1.44)	(0.35)
Mobility	0.022	0.013
	(1.72)	(0.82)
Age dummies	No	Yes
Observations	2852	2601
Observed probability	0.102	0.102
Pseudo R^2	0.018	0.066

Note: Logit estimation. Marginal effects are presented calculated observation by observations, as an alternative to the evaluation of the marginal effect at the mean value of *x* over the sample used, which is not reliable when some elements of *x* are binary. Robust z-stat in parentheses. Omitted dummies are no education, female, single and catholic. The type of housing materials (soft roof and house, mixed or hard roof and house) serves as a proxy for wealth. The indicator for mobility takes the value 1 if the individual goes more than once a year outside the country. The sample size decreases when age dummies are included since at very old age nobody is HIV positive.
Source: MRC General Population Cohort 1989/90 (round 1).

Table 3: Early marriage as a determinant for being HIV positive for women who have been married by age groups for five African countries

	Burkina Faso		Cameroon		Ghana		Kenya		Tanzania	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
	All	Sexually active	All	Sexually active	All	Sexually active	All	Sexually active	All	Sexually active
					Age 15-19					
Ever married	-0.0168**	-0.0347**	0.0251*	0.0140	0.0236	0.0188	0.0192	0.0430	0.0121	0.0195
	[0.0072]	[0.0167]	[0.0147]	[0.0221]	[0.0158]	[0.0158]	[0.0241]	[0.0281]	[0.0165]	[0.0201]
Observations	945	425	1274	743	1011	388	732	314	1255	605
R-squared	0.04	0.10	0.06	0.11	0.06	0.10	0.10	0.15	0.05	0.07
					Age 20-24					
Ever married	-0.0655*	-0.0849*	0.0172	-0.0127	-0.0234*	-0.0355**	0.0236	0.0094	0.0342*	0.0231
	[0.0354]	[0.0465]	[0.0236]	[0.0291]	[0.0127]	[0.0165]	[0.0254]	[0.0315]	[0.0207]	[0.0230]
Observations	755	716	1062	1001	897	764	681	580	1182	1102
R-squared	0.10	0.10	0.09	0.11	0.05	0.06	0.18	0.19	0.06	0.07
					Age 15-24					
Ever married	-0.0299**	-0.0573**	0.0238*	0.0099	-0.0038	-0.0125	0.0279	0.0258	0.0234*	0.0206
	[0.0132]	[0.0240]	[0.0126]	[0.0172]	[0.0101]	[0.0125]	[0.0182]	[0.0218]	[0.0128]	[0.0152]
Observations	1700	1141	2336	1744	1908	1152	1413	894	2437	1707
R-squared	0.04	0.07	0.07	0.08	0.03	0.04	0.12	0.14	0.05	0.05

Notes: Robust standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 4: Discordance in HIV status among cohabiting couples (percent)

	Burkina Faso 2003 (n=2,157)		Cameroon 2004 (n=2,105)		Ethiopia 2005 (n=2,480)		Ghana 2003 (n=1,825)		Guinea 2005 (n=1,851)	
HIV status of couple	All couples	Infected couples	All couples	Infected couples	All couples	Infected couples	All couples	Infected couples	All couples	Infected couples
Concordant negative	96.90	*n.a.*	92.57	*n.a.*	97.97	*n.a.*	95.84	*n.a.*	98.09	*n.a.*
Concordant positive	0.45	14.83	2.35	31.68	0.28	13.83	0.91	22.05	0.35	18.37
Discordant male	1.69	54.92	2.42	32.61	0.76	37.95	1.67	40.26	0.92	48.62
Discordant female	0.93	30.24	2.65	35.69	0.97	48.20	1.56	37.68	0.62	32.99

	Ivory Coast 2005 (n=1,250)		Kenya 2003 (n=1,086)		Lesotho 2004 (n=652)		Malawi 2004 (n=1,297)		Niger 2006 (n =2,035)	
	All couples	Infected couples	All couples	Infected couples	All couples	Infected couples	All couples	Infected couples	All couples	Infected couples
Concordant negative	93.26	*n.a.*	89.06	*n.a.*	66.90	*n.a.*	83.17	*n.a.*	98.87	*n.a.*
Concordant positive	1.21	18.00	3.64	33.36	19.53	58.99	7.07	42.04	0.17	15.37
Discordant male	2.07	30.82	2.84	26.01	8.96	27.06	5.63	33.48	0.57	51.65
Discordant female	3.44	51.17	4.44	40.62	4.62	13.95	4.11	24.47	0.37	32.97

	Rwanda 2005 (n= 2,140)		Senegal 2005 (n= 1,197)		Tanzania 2003-04 (n=2,214)		Zimbabwe 2005-06 (n= 1,847)	
	All couples	Infected couples	All couples	Infected couples	All couples	All couples	All couples	Infected couples
Concordant negative	96.12	*n.a.*	98.72	*n.a.*	89.52	n.a.	72.51	*n.a.*
Concordant positive	1.69	43.69	0.45	(*)	2.59	24.79	14.59	53.12
Discordant male	1.38	35.71	0.44	(*)	4.39	41.95	7.62	27.75
Discordant female	0.79	20.59	0.37	(*)	3.48	33.24	5.25	19.12

Notes: *n.a.*= not applicable. (*): based on number of observations to low (<25) for meaningful statistics. The data are weighted with the sample weights given by the data provider.

Concordant negative means that both partners are HIV-negative, concordant positive means that both are HIV-positive, discordant male means that only the man is HIV-positive and discordant female means that only the woman is HIV-positive.

Table 5: Discordance in HIV status among couples where the woman has not been in more than one marriage and has been in the union for 10 years or more (percent)

	Burkina Faso 2003 (n=1,002)		Cameroon 2004 (n=748)		Ethiopia 2005 (n=1,112)		Ghana 2003 (n= 812)		Guinea 2005 (n=956)	
HIV status of couple	All couples	Infected couples	All couples	Infected couples	All couples	Infected couples	All couples	Infected couples	All couples	Infected couples
Concordant negative	97.01	*n.a.*	95.65	*n.a.*	99.29	*n.a.*	97.00	*n.a.*	98.73	*n.a.*
Concordant positive	0.48	16.17	1.75	40.33	0.21	(*)	1.05	(*)	0.38	(*)
Discordant male	1.70	57.09	1.13	26.04	0.31	(*)	1.35	(*)	0.80	(*)
Discordant female	0.79	26.73	1.46	33.61	0.17	(*)	0.59	(*)	0.08	(*)
	Ivory Coast 2005 (n=458)		Kenya 2003 (n=482)		Lesotho 2004 (n=269)		Malawi 2004 (n=439)		Niger 2006 (n =951)	
	All couples	Infected couples	All couples	Infected couples	All couples	Infected couples	All couples	Infected couples	All couples	Infected couples
Concordant negative	94.21	*n.a.*	92.24	*n.a.*	72.01	*n.a.*	86.87	*n.a.*	98.94	*n.a.*
Concordant positive	0.51	8.90	3.21	41.47	15.61	55.77	6.42	48.95	0.16	(*)
Discordant male	2.35	44.48	2.71	28.08	9.23	32.96	4.00	30.54	0.84	(*)
Discordant female	2.90	50.31	2.35	30.43	3.15	11.27	2.69	20.50	0.04	(*)
	Rwanda 2005 (n= 939)		Senegal 2005 (n= 516)		Tanzania 2003-04 (n=784)		Zimbabwe 2005-06 (n= 716)		*Notes*: *n.a.*= not applicable. (*): based on number of observations to low (<25) for meaningful statistics. The data are weighted with the sample weights given by the data provider.	
	All couples	Infected couples	All couples	Infected couples	All couples	Infected couples	All couples	Infected couples		
Concordant negative	96.18	*n.a.*	99.14	*n.a.*	90.79	*n.a.*	74.92	*n.a.*		
Concordant positive	1.53	40.25	0.08	(*)	3.20	34.84	11.67	46.58		
Discordant male	1.69	44.48	0.49	(*)	3.97	43.17	9.11	36.37		
Discordant female	0.58	15.26	0.28	(*)	2.02	21.97	4.27	17.04		

The sample excludes couples where the female has been in successive marriages as well as unions with duration of less than 10 years. Concordant negative means that both partners are HIV-negative, concordant positive means that both are HIV-positive, discordant male means that only the man is HIV-positive and discordant female means that only the woman is HIV-positive.

Appendix Table 1: HIV prevalence and Population in Sub-Saharan Africa

	HIV prevalence	Population (millions)	Overall population share by HIV prevalence	
			<5%	>= 5%
Angola	3.7	13.5	1.9%	
Benin	1.8	6.7	1.0%	
Botswana	24.1	1.7		0.2%
Burkina Faso	2.0	12.1	1.7%	
Burundi	3.3	7.2	1.0%	
Cameroon	5.4	16.1		2.3%
Central African Republic	10.7	3.9		0.6%
Chad	3.5	8.6	1.2%	
Côte d'Ivoire	7.1	16.8		2.4%
Democratic Republic of Congo	3.2	53.2	7.6%	
Eritrea	2.4	4.4	0.6%	
Ethiopia	1.4	68.6	9.8%	
Gabon	7.9	1.3		0.2%
Gambia	2.4	1.4	0.2%	
Ghana	2.3	20.7	3.0%	
Guinea	1.5	7.9	1.1%	
Guinea-Bissau	3.8	1.5	0.2%	
Kenya	6.1	31.9		4.6%
Lesotho	23.2	1.8		0.3%
Madagascar	0.5	16.9	2.4%	
Malawi	14.1	11.0		1.6%
Mali	1.7	11.7	1.7%	
Mauritania	0.7	2.8	0.4%	
Mauritius	0.6	1.2	0.2%	
Mozambique	16.1	18.8		2.7%
Namibia	19.6	2.0		0.3%
Niger	1.1	11.8	1.7%	
Nigeria	3.9	136.5	19.5%	
Rwanda	3.1	8.4	1.2%	
Republic of Congo	5.3	3.8		0.5%
Senegal	0.9	10.2	1.5%	
Sierra Leone	1.6	5.3	0.8%	
Somalia	0.9	9.6	1.4%	
South Africa	18.8	45.8		6.5%
Sudan	1.6	33.5	4.8%	
Swaziland	33.4	1.1		0.2%
Togo	3.2	4.9	0.7%	
Uganda	6.7	25.3		3.6%
United Republic of Tanzania	6.5	35.9		5.1%
Zambia	17.0	10.4		1.5%
Zimbabwe	20.1	13.1		1.9%
TOTAL		699.3	66%	34%

Notes: Excludes Cape Verde, Comoros, Djibouti, Sao Tome and Principe, Seychelles, Equatorial Guinea, and Liberia. *Sources*: HIV prevalence is UNAIDS Report on the Global AIDS Epidemic (2006) and population estimates from World Development Indicators Reports 2005-2007.